

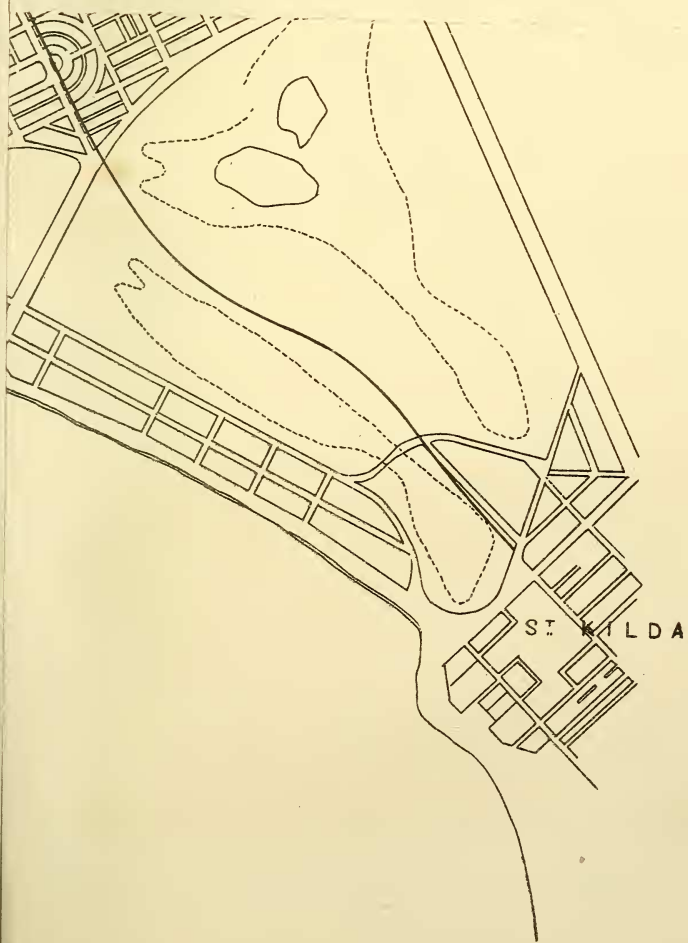
not unlikely Leichhardt had to encounter it during his last expedition. The occupants of territory in which the plant occurs may now, however, guard to some extent against this vegetable bane, since the plant has become widely known, nor is it unlikely that by setting fire repeatedly to the vegetation of the scrubby ridges on which it grows, that it may be extirpated. *Gastrolobium grandiflorum* is the only species of the genus as yet found beyond south-west Australia, where several congeners (for instance, *G. bilobum*, *G. calycinum*, *G. callistachys*, *G. oxylobioides*), on account of their poisonous properties, render extensive tracts of the country unoccupiable. I shall have a future occasion to enter on detailed statements of the effects of the *Gastrolobia* on the animal frame, and give also the results of the chemical analysis of these plants. Expositions of the highly deleterious effect of the *Swainsona Greyana*, which as a pasture herb on the Darling flats, frequently causes the death of horses during dry seasons, when other herbage fails, as well as an explanation of the deadly effect of the *Lotus Australis*, causing, when grown and depastured in certain localities, sheep to perish within half an hour, may, as referring likewise to leguminous plants, then come simultaneously within the precincts of my elucidation.

ART. XXXV—*Yarra Floods and their Remedy.* By
ROBT. ADAMS, Esq., C.E.

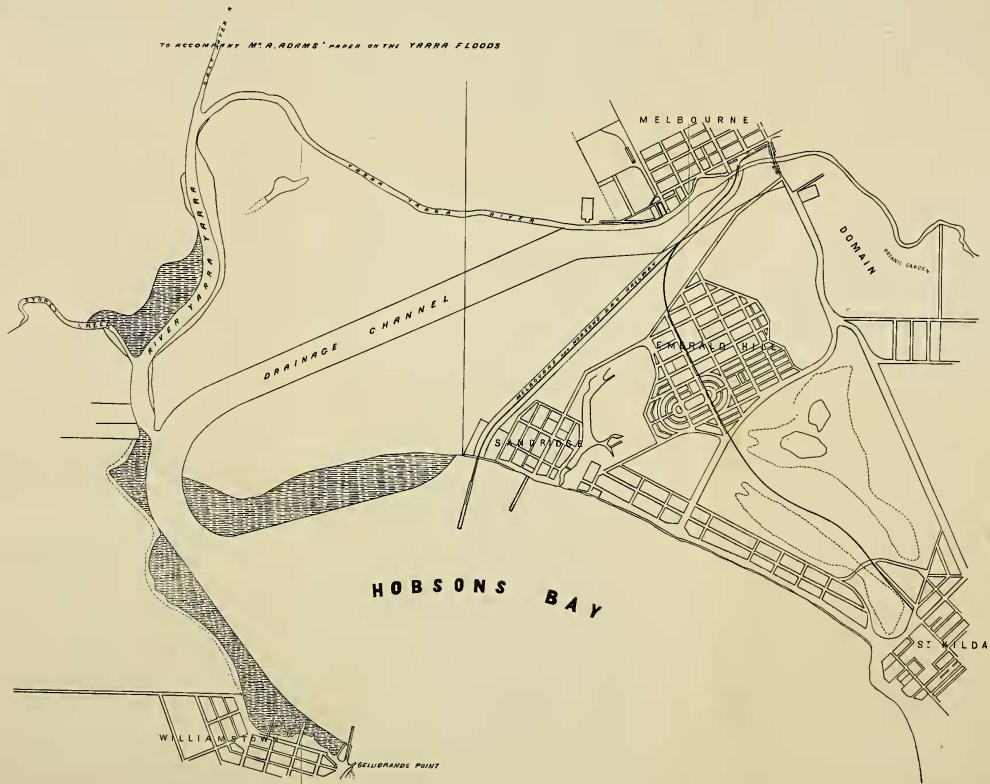
[Abstract of Paper read 16th July, 1864.]

In this paper I propose to examine into the various means that have been suggested for preventing Floods in the River Yarra, and to bring before the Society a scheme that I confidently believe would thoroughly meet the difficulty.

The first object to be attained, is clearly, I think, to select the most suitable point of ultimate discharge of the flood waters into the Bay. There are only four sites possible for an outlet. First, the Yarra mouth; second, between the Yarra mouth and the Sandridge railway, at or near the site proposed as an entrance for a ship-canal in 1853; third, at the Sandridge lagoon; fourth, at a spot a little to the westward of St. Kilda. Amongst these four sites an outlet must be selected. Whatever means may be adopted by an artificial channel or otherwise, to bring the flood waters from



TO ACCOMPANY MR. A. ADAMS' PAPER ON THE YARRA FLOODS



above Prince's Bridge to the lower side of the Falls, a suitable channel must be formed for passing those waters from the Falls to the Bay, and an efficient outlet into the Bay must also be constructed. Neither of these agencies exists at present. This is evident from the fact, that during heavy floods the waters after passing the obstructions in their course between their source and the Falls, instead of escaping at once into the Bay, as they would do if the river channel were equal to its requirements are checked in their outflow until they inundate the low-lying lands about Melbourne, and rise to such a level as to drown a large extent of property. A considerable amount of injury is, doubtless, occasioned to land adjoining the river above Prince's Bridge, but the injury is small as compared with that done below. The main difficulty to be dealt with is manifestly that of providing for the escape of the flood-waters into the Bay. The difference of level between the river at the Queen's Wharf and the water in the Bay during floods is so slight, through the water in the Bay being driven up to a high level by the southerly winds which prevail during those periods, that the escape of the upland waters into the Bay becomes seriously checked, and the backwater, thus formed, spreads over the low lands. To meet this difficulty it is imperatively necessary to construct a wide channel and outlet. A deep narrow channel is evidently useless, as it could possess no outward current below the line at which the force of the down flowing waters ceased to overpower the opposing mass of water in the Bay. The channel should then be of such a width and depth that throughout the whole extent of its sectional area the water would be in motion in an outward direction. Knowing, as we do, the height to which the waters rose in the Yarra above Prince's Bridge during the December floods, and knowing also the level of the southern approach to that bridge, we have absolutely reliable data as to the quantity of water for the passage of which provision has to be made. With this information to guide us, combined with existing records as to the height of the water in Hobson's Bay, as registered by the tide-gauge at the time of the late floods, the requisite width and depth of the flood channel can be arrived at with positive certainty.

It is obvious, that a channel of sufficient discharging power to accommodate the exit of the flood-waters without injury to property about Melbourne, cannot be constructed

without a large outlay of capital, in whatever direction it may be formed. It therefore becomes a question for serious consideration, whether it would not be prudent to select such a site for the channel as would admit of the course being, at least ultimately, converted into a highway for the transit of shipping to and fro, between Hobson's Bay and the Queen's Wharf. If such a line of channel can be selected as will be most suitable both for discharging the flood-waters and for the passage of shipping, there can be but little doubt that that route ought to be adopted. The plan which accompanies this paper, shows the route which I consider the most suitable for both these purposes.

The suggestions for making a canal from Prince's Bridge through the Sandridge lagoon into the Bay, and that for cutting a canal from the former point and by way of the swamps east of Emerald Hill through the St. Kilda Park into the Bay, are open to the objection, that neither scheme offers the inducement of a ship-canal, with docks at Melbourne. Both of these routes are intersected by the St. Kilda railway, and therefore the communication for shipping between the Bay and Melbourne, under either plan would be severed. Even if the shipping could traverse the St. Kilda railway, there is no site at Melbourne where docks could be constructed within reach of either of these artificial channels. It would not be possible to construct an entrance for a canal or for an embouchure for flood-waters, at one or other of these sites, that would not surely and rapidly be choked with silt and sand. At the Sandridge lagoon site, the extent of sandy foreshore is not so great as at St. Kilda. There is, however, sufficient deposit there to afford strong grounds for believing that an opening through the beach made at that point would be speedily blocked up by sand driven along the shore by southerly winds. The sands thus deposited at the mouth of a canal disemboguing at that point, could only be removed by dredging, or by some other artificial means. Irrespective of the large annual outlay required in dredging, it has not yet been shown that it would be practically possible to preserve an outlet channel that would be constantly available for the discharge of flood-waters. Whatever disadvantages the Sandridge lagoon outlet possesses in this respect, they appear to me to be much greater in that suggested at St. Kilda. From the length of the channel, the cost of construction, the difficulties attending the formation of the outlet into the Bay, and the expense

of the subsequent operations necessary for removing the sandy deposit at the mouth, the St. Kilda channel appears to me to be worse than the Sandridge lagoon channel. In fact, there are no valid arguments that I can discern in support of the St. Kilda scheme.

The line of channel proposed in 1853, for a ship-canal, differs materially as regards results from those last mentioned, inasmuch as, if suitable for a flood-channel, it would also be available for giving passage to shipping between the Bay and Melbourne. It is doubtful, however, if an outlet for flood-waters formed at the point at which the entrance to that canal was proposed to be made would be effectual. The tendency of the mouth to choke with silt would be similar to that of the two schemes last mentioned. The argument has been frequently made use of, that because the deep water penetrates more closely into the shore at that point than at any other, the mouth of a canal would be less liable to obstruction from deposit of sand there than elsewhere. But it must be recollected that the conditions of the case would be entirely altered if the upland waters emptied themselves through a channel having an outlet at that site. The waters of the Bay driven up by southerly winds, culminate in force at that part of the shore, and coming over the deep waters of the Bay, hold little or no debris in suspension. It is not surprising that a body of water, free from a mixture of solid matter being hurled against the shore, wave after wave, during the southerly winds, gradually eats away the bank of sand formed during easterly winds, and scatters the deposit right and left, to be deposited on the eastern side upon the shore; and on the western side, to be carried away by the natural currents into deep water. Were an open cutting to be formed emptying into the Bay at this point, the state of the case would be entirely altered. The beat of the waters of the Bay is at present against a solid shore, on which the only effect that can be produced is, the carrying away of the sand to other sites immediately adjoining, or the floating away of the material into deep water. But if the outfall of the Yarra discharged into the Bay at this locality, the results would evidently be wholly different. Then the force of the waters of the Bay during southerly winds, instead of being expended, as now, in breaking fruitlessly upon the shore, would drive the sand into the mouth of the canal with far greater force than the outward current could resist. At the point where the forces of the out-flowing

waters on the one hand, and of the opposing waters of the Bay on the other, neutralized each other, the debris surged up from the beach, and the silt carried down the Yarra from the lands draining into that river must inevitably be deposited. It would be absurd to doubt that this effect would be produced, especially when we bear in mind that the outlet, formed at the mouth of the Sandridge lagoon during the late floods, was silted up in two or three weeks afterwards, although nine feet in depth. Well-known natural laws prove to us, without other evidence, that such an outlet must silt up. The only question that can arise is, as to the probable extent of the deposit and the cost of its removal. I am satisfied that no engineer would attempt to dispute that a deposit would accumulate at the mouth, and I believe that the extent of the deposit would be sufficiently large to render the outlet inefficient for its intended purpose. At any rate the injury that would be inflicted on the jetty of the Hobson's Bay Railway Company and on the Sandridge Town Pier, cannot be overlooked. An outlet at the site referred to could not avoid silting up those works, and the injury done to them could not be easily remedied. The wharfage works, on the opposite shore of the Bay at Williamstown, would likewise receive injury, as they would lose the scouring effect of the present current from the Yarra along the Williamstown shore. They would also be injured by the deposit of silt on that shore which would necessarily follow the conversion of the bight westward of Williamstown and Sandridge into a reservoir of dead water. In each of the three projects alluded to, the mouth of the channel must necessarily be exposed to the whole fetch of the bay; and whatever advantages either may individually possess, it is evident, from the latter circumstance, that the escape of the flood-waters would be seriously retarded by the opposing influence of the waters of the Bay driven up by southerly winds against the northern unprotected shore. This alone is a material objection to the adoption of any canal emptying itself into the bay at either of the sites I have referred to. When we take into consideration the positive evils that would follow the carrying out of either of these schemes, I think sufficient grounds are apparent why neither project should be put in practice.

The scheme suggested by me, as shown on the map, includes two important features which an enlarged consideration of the subject has induced me to regard as essential to

uccess. These are, the permanent adoption of the site of Prince's Bridge and that of the present Yarra mouth as points of discharge for the waters of the Yarra. The onus of proving the benefits that would result from diverting the natural channel of the river above Prince's Bridge, necessarily falls upon those who advocate the construction of works, contemplating the discharge of the waters by some other route.

The advantages which I claim in favour of my plan over others are—that the currents of the Bay are not interfered with, and therefore that the existing piers and other works of construction are not injured; that the mouth of the channel is in the position least liable of any to silt up from many obvious reasons, and that it is so situated, being under the lee of Williamstown and Gellibrand's Point, as to afford an entrance for shipping thoroughly protected during all weathers. In this proposition, also, the general question of the future development of the harbour, as circumstances may require, is dealt with. The benefit resulting from the passing of the whole of the waters of the River Yarra, the Saltwater River, and the Stoney Creek, through the one outlet, ought not to be undervalued, as the accumulated scour of the three streams must certainly be more effective, in preventing a deposit of silt from forming, than the unaided upland waters of the Yarra discharging at a separate outlet. The only conceivable objection that can be urged against the scheme is, that the channel is longer than a direct channel from Prince's Bridge to Sandridge. Even from this point of view the route I have suggested has its advantages. The flood-channel, on whatever line it may be constructed, will eventually, at any rate, be made of sufficient depth to accommodate shipping; when this occurs the channel itself will become a dock. The greater its length the more dock accommodation for shipping it will afford and the larger amount of wharfage frontage it will present. The diagonal course which the channel takes through the low lands also divides the ground in a manner which will give the greatest available access from the wharfs to the adjoining lands.

As already stated, the cutting must be of great width to afford a safe channel of discharge for the Yarra waters during periods of floods. This width is far greater than, in all probability, will ever be required for the accommodation of shipping. It would then be useless to make the channel,